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## CHAPTER 4

# PC 2001 Core System Guidelines

**INDUSTRY EARLY REVIEW DRAFT V.0.3 — 07/20/1999 3:07 PM—**

**NOTE to REVIEWERS:** This is a very early draft version, and no effort has been made to reconcile changes in cross references to other chapters in the guide. Please look for comments such as this in the draft, which encourage your feedback on specific issues.

**Please submit comments using the form on <http://www.pcdesguide.org> or by sending e-mail to [comments@pcdesguide.org](mailto:comments@pcdesguide.org).**

**IMPORTANT:** The requirements defined in this guide provide guidelines for designing PC systems that will result in an optimal user experience with typical Windows-based applications running under either the Microsoft Windows98 “Millennium” or later or Windows2000 Professional or later operating systems. These design guidelines are not the basic system requirements for running any version of Windows operating systems.

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This chapter summarizes the basic features required for all PC 2001 systems.

For definitions of common terms, acronyms, and abbreviations used in this guide, see the Glossary; see also “Conventions Used in This Guide” in “Welcome.”

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## PC 2001 General System Requirements

This section presents a summary of the general system requirements and recommendations, including system board, memory, and BIOS requirements.

### [3.1.] System performance meets PC 2001 minimum requirements

The performance requirements for PC 2001 systems are based on the minimum computational capabilities and performance necessary to support the demands of Windows-based applications together with the estimated processing demand and processing capability of the lowest-end processor in mid-2001.

The minimum performance requirement consists of the following:

?? [3.1.1.] System includes CPU and L2 cache that meets PC 2001 minimum requirements. The minimum microprocessor capability is specified to support the demands of rich media, Internet access, and conferencing. The performance requirement for media enhancement is specified to ensure that the system meets performance targets at minimum platform power.

~~This processor requirement does not specify a particular processor form factor or package type. The processor requirements are:~~

?? Desktop PC: ~~300-400~~ MHz Intel Architecture compatible processor with 128K Level 2 (L2) cache

?? Mobile PC: ~~233-300~~ MHz Intel Architecture compatible processor with 128K L2 cache

?? Workstation PC: ~~400-500~~ MHz or greater Intel Architecture compatible processor with 256K L2 cache per processor

**Note to Reviewers: Please comment on the minimum baseline you believe will apply for the 2001 timeframe. In the 0.5 draft, these requirements will be in the platform-specific chapters for mobile, desktop, and workstation.**

~~Recommended:~~The processor should support multimedia extensions.

This processor requirement does not specify a particular processor form factor or package type. Alpha architecture implementations that meet or exceed these performance requirements are also acceptable for systems that run Windows 2000.

?? [3.1.2] System memory meets PC 2001 minimum requirements.

**Note to Reviewers: In the 0.5 draft, these requirements will be in the platform-specific chapters for mobile, desktop, and workstation.**

?? Desktop and Mobile: 64 MB required

?? Workstation PC and Easy PC: 128 MB RAM

For all systems, a minimum of 28 MB of memory must be available for the system to use at boot time. These minimum RAM requirements do not preclude applications that use dynamically allocated memory for audio or video playback or other temporary uses.

?? [3.1.3] APIC support, is present, is clocked and wired.

All desktop systems are required to have APIC implemented and properly connected, so that the system can be configured either in APIC mode or in the standard PIC ("virtual wire") mode. Both these modes must be supported for system to boot properly.

For background information, see *Key Benefits of the I/O APIC* at <http://www.microsoft.com/hwdev/newpc/io-apic.htm>.

For technical information about how to implement this requirement, see the related chip set guide from your chip set vendor.

**Note:** All requirements in this guide for Alpha architecture apply to the Windows 2000 operating system only. There are no plans to enable Windows to run on Alpha architecture.

*Mobile PC Note*

For complete performance guidelines and exceptions for workstation and mobile PCs, see Chapter X, "Workstation PC 2001," and Chapter X, "Mobile PC 2001."

[3.2] System design meets ACPI ~~x.x~~ specification and PC 2001 requirements

**NOTE TO REVIEWERS:** ACPI requirements in PC 2001 will be based on ACPI 1.0a, plus future ACPI revisions, as defined and accepted in 1999. It is not known at this time whether ACPI 2.0 will be completed and accepted before completion of the PC 2001 guide. It is expected that a revision of ACPI in 1999 will define capabilities reporting needed for legacy-free systems., which will become requirements for PC 2001 Legacy Free PCs.

**Also, exceptions for mobile PCs cannot be identified in v.0.3.**

The system board must support *Advanced Configuration and Power Interface Specification, Revision ~~1.0a~~x.x* or later. This requirement ensures that the system correctly supports Plug and Play and power management.

ACPI support must include the following:

?? [3.2.1] System includes power management timer, button, and alarm.

The system must include a power-management timer and Power button in compliance with the ACPI ~~1.0a~~x.x specification. This button should be implemented as described in requirement 3.3, "Hardware design supports OnNow and Instantly Available PC initiatives." A separate reset switch is an acceptable alternative to the ACPI-specified override mechanism.

The real-time clock alarm must support wake-up ~~due to~~ at a scheduled time and day of the month. Notice that the day-of-month feature is a requirement, although it is an optional feature in the ACPI ~~1.0a.x.x~~ specification.

The system must also provide a system control interrupt and Status and Enable (STS/EN) bits for the power-management timer, power button, and real-time clock.

?? [3.2.2] System supports S3 and S5 states, plus S4BIOS. The system must support the S5 (soft-off) state, as required in the ACPI ~~1.0a.x.x~~ specification or later, plus S3 and either S1 or S2 plus S4BIOS. Support of S4 is optional. ~~S3 sleep state, meaning Suspend To RAM, must be supported to provide the optimal user experience and power savings.~~

~~Recommended: The system supports one sleep state that reduces overall system power consumption in accordance with the EPA ENERGY STAR guidelines for computers.~~

**Note to Reviewers:** We do not want to define this requirement in terms of “support S3 and S4.” It would be preferable to state this in terms of the desired user experience, such as “Optimal user experience for suspend, shutdown, and hibernate, including the preconfigured system state and network/Internet connections.”

However, the following operating system behaviors are not yet defined by Microsoft.

?? [3.2.3] System includes a description table for system-board devices and ACPI control methods for configuring buses and devices. The description table for system-board devices (including host PCI bridges) defines the complete hierarchy, including all non-Plug and Play devices to be enumerated and all other devices for which power management or removal capabilities have been added in the system-board design.

The system must include ACPI control methods necessary for configuring each bus and device enumerated using ACPI, as described in guideline [3.12], “Each bus and device meets Plug and Play specifications.”

?? [3.2.4] Devices that support wake up, such as USB controllers, must be able to wake the system from the S3 sleep state and at least one more supported sleep state~~in addition to the S3 sleep state.~~

The Universal Serial Bus (USB) host controller and other devices that support wake-up capabilities must support wake-up capabilities from S3 and at least in one of the following system states: S1 or S2.

~~Notice that if wake-up from the S2 or S3 state is supported,~~ Wake-up must be supported for all higher power sleep states. For example, if the controller supports wake-up from the S2 state, it must also support wake-up from the S1 state.

?? [3.2.5] System provides no user-accessible method for disabling ACPI in the BIOS. If the system includes a BIOS setting that the manufacturer can

use to switch between ACPI and APM modes, this setting must not be exposed to the end user in a CMOS setting or other means once a Microsoft ACPI-enabled operating system has been installed. Disabling ACPI will cause boot failures, because Windows 2000 relies on it for identification and initialization of system devices. Not having an option to “disable” ACPI support does not impact the ability to properly load an operating system that is not ACPI compatible.

The following power management features are recommended for all PC 2001 systems:

~~? System should implement ACPI thermal model and fan control. It is recommended to implement a thermal model and fan control as defined in Section 12 of the ACPI 1.0a specification as a means of running the PC quietly while it is working and turning the fan off while it is sleeping.~~

~~Notice that a hardware-based, open-loop thermal control is an acceptable implementation for system cooling if it meets requirement [3.7], “Audible noise meets PC 2001 requirements.” However, the recommended implementation is a closed-loop control using the PC’s processor, an embedded controller, or both. If a closed-loop implementation is used, it must comply with the ACPI 1.0a specification or later.~~

~~**BIOS must support standard options for automatic restart in the event of system power loss.** BIOS must have a setup option that allows users to select the desired restart behavior of the PC after a system power loss. Systems should provide three standard restart options:~~

- ~~1) Always restart~~
- ~~2) Remain off~~
- ~~3) Return to the same state (either off or on) as before power loss~~

~~The third option (return to last state) should be set as the system default.~~

~~If this restart selection feature is supported, it must be implemented as an OEM extension using ACPI control methods to facilitate future standardization and enhanced support in the Microsoft Windows family of operating systems such as a standard application programming interface (API).~~

~~Also, in addition to any user interface provided by a BIOS setup program, a user interface to select the restart option must be implemented as a property-page extension to the Windows Power Management control panel.~~

**Note:** Any other system-board power management or Plug and Play features must be implemented in compliance with the ACPI x.x or later specification, even if a particular feature is not a specific requirement or recommendation.

### [3.3.] Hardware design supports OnNow and Instantly Available PC initiatives

Elements of the Instantly Available and OnNow design initiatives ensure that the operating system and device drivers control the state of individual devices and the

system board. The Instantly Available PC initiative is fully consistent with the OnNow design initiative and provides guidelines for hardware design to ensure efficient power management on the desktop.

These initiatives are based on these goals for the user experience:

- ?? The user experiences the PC as off when it is in a sleep state
- ?? The user can easily see whether the PC is working or sleeping
- ?? The user can easily control power through switches and software

Based on these goals, the following is required to support the OnNow and Instantly Available PC initiatives:

- ?? **[3.3.1] System and devices appear as off in the sleep state.** At a minimum, all media drives, display, sound, input devices, and fans must be perceived as off ~~while~~when the system has completed the transition to ~~is in~~ a sleep state, for example, no noise or lights other than the status indicator.

- ?? **[3.3.2] System provides one or more indicators to show whether the system is in the working or sleep state.**

This requirement applies for S1, S2, and S3 system states.

~~Recommended:~~An indicator should be a non-flashing, light-emitting diode (LED) sleep indicator that is a different color than the wake indicator. A slowly blinking LED indicator (less than 1 Hz) is also an acceptable implementation.

The nonvolatile sleep state, S4 or S4BIOS, should appear to the user as the off state (S5); therefore, all of these states should have the same indicator.

If telephone answering machine capabilities are built into the system, ~~then~~ a Message Waiting indicator should be included on desktop systems.

- ?? **[3.3.3] System provides software-controlled, ACPI-based power switch.** The system must provide an easily accessible power switch that can be controlled by software and that supports the functionality required in Section 4.7.2.2.1 of the ACPI ~~4.0~~x.x specification.

This requirement for an easily accessible power switch does not preclude power-control capabilities, such as closing the lid on a mobile PC.

**The following provides implementation guidelines for the power switch:**

- ?? The power switch can be implemented as either a power button or a sleep button. ~~It is recommended to~~ Implementing both buttons for desktop and mobile PCs is encouraged. If both buttons are implemented, the sleep button should be the user's primary switch interface and must be easily distinguishable from the power button. The preferred implementation is to hide the power button.

- ?? The function of these buttons is determined by the operating system. The default action for the sleep button is to cause the machine to enter a sleep

state. The default action for the power button is to shut down the operating system and power off the machine.

In a single-button configuration, the button can be used for either sleep/wake transitions (G0<->G1/S1-S4) or off/on transitions (G0<->G2/S5), depending on user preference and the policy set in the operating system.

In a two-button configuration that includes separate power and sleep buttons, the user interface provided by the operating system will allow only the default actions.

?? In case of a hardware or software failure that prevents normal operation of the software-controlled buttons, the switch capabilities must include an override mechanism for turning off the PC.

A 4-second override mechanism is recommended in Section 4.7.2.2.1 of the ACPI 4.0a.x or later specification. The override can be on either the power button or the sleep button in a two-button configuration, but ~~it is recommended that~~ the override should be associated with the sleep button in order to establish an industry-standard implementation.

An acceptable but not ~~recommended~~ encouraged alternative to the 4-second override is a separate hidden or recessed switch that cannot be mistaken for either the power button or the sleep button.

Notice that the override mechanism is not an alternative way for the user to turn off the PC in normal operation; it is only a fail-safe function for fault conditions.

?? If the power switch is provided on the keyboard, the key must be clearly labeled and must consist of a single keystroke for turning on the PC, to ensure accessibility for persons with disabilities. (Two keystrokes can be used to turn off the PC.) For information about scan codes for keyboard power switches, see the information available on the web site at <http://www.microsoft.com/hwdev/desinit/scancode.htm>.

**Note to Reviewers: Highlighted material is expected to move to a separate doc at 0.5 time frame. This is consistent with goal of reducing size by 50%.**

?? [3.3.4] Each device supports the power management specifications for its class. All devices and drivers must support the D0 and D3 power states consistent with the definitions in the relevant device class power management reference specification and the *Default Device Class Power Management Specification, Version 1.0* or later. Support of D1 and D2 states is optional, unless stated as required in the relevant device class specification.

~~Therefore, This means that~~ each device can successfully survive a system sleep/wake transition (where the device transitions from D0 to D3 to D0) without losing functionality and without requiring user intervention to restore

functionality. This requirement applies whether or not system power is removed while the device is in the D3 power state.

There is no power consumption requirement for devices in the D3 power state. However, devices should implement the D3 power state such that device power consumption is reduced to near zero. This guideline includes no requirement to retain any device context because it will be preserved or restored by the driver when returning to the D0 power state.

PCI, USB, IEEE 1394, and PC Card buses must support power management requirements as defined in their related bus standards. For information, see the respective chapters in Part 3 of this guide.

- ?? [3.3.5] **System power supply provides “standby” power for system wake-up events.** A minimum of 720mA of “standby” power is required to support wake-up devices on PCI or USB when the system is in the ACPI S3, S4, or S5 state. For more information, see the Instantly Available PC System Power Delivery Requirements and Recommendations available from the web site at <http://developer.intel.com/design/power/supply98.htm>.

*Mobile PC Note*

~~This requirement for the system power supply does not apply to mobile PCs.~~

**Note to Reviewers: PC 2001 will propose new implementation requirements for the power switch to improve ease of use. These requirements have not yet been defined. Reviewers are encouraged to provide detailed suggestions for this guideline in their comments.**

#### [3.4.] BIOS meets PC 2001 requirements for OnNow/Instantly Available PC support

This requirement does not apply for Alpha architecture, except for the requirement for fast power-on self test (POST).

The intention of this requirement is to ensure that the end user is not presented with confusing information and unnecessary visual display, and to ensure that access to error information remains available using a hot key.

In addition to the PC 2001 requirement to support S4BIOS, the following BIOS capabilities are required for OnNow support:

- ?? [3.4.1] **BIOS supports Fast POST.** The system must be available to the user as quickly as possible. ~~Although a specific time limit is not established,~~ The requirement is that power on to the bootstrap loader handoff occurs in 5 seconds or less, plus hard disk ready time, option ROMs, and time required for error correction code (ECC) scrubbing.

~~Future design guidelines are likely to require a specific time limit for boot speed. In the meantime, the following are recommended ways to reduce processing overhead to make system boot time as fast as possible:~~

~~? No video memory test and limited test DRAM size.~~

~~? No tests for serial or parallel ports.~~



~~? No floppy disk test or media check (the system boots from a hard disk or network).~~

~~? No tests for the hard disk controller or drive type (if the system does not include swappable drives).~~

~~? Test execution is controlled using Windows-based control panel or application that can be scheduled to run periodically at off hours.~~

~~? Fast POST mode for BIOS (the mode can be disabled by the user for troubleshooting).~~

~~Compliance with the *Simple Boot Flag Specification, Version 1.0* or later.~~

~~This enables the BIOS to boot quickly when the last boot was successful and to perform diagnostics only if a problem occurred on the previous boot. Enabling and disabling this feature can be provided in the BIOS configuration program for compatibility with operating systems that do not support the Simple Boot Flag.~~

?? [3.4.2] **Resume from sleep state (S1–S4) to operating system handoff occurs within 500 ms.** This requirement does not apply for the S4BIOS state. For all other sleep states, the time to operating system handoff is measured from when the processor starts running (first instruction) until the BIOS jumps to the Waking Vector in the ACPI firmware control structure table, as described in Section 5.2.6 in the ACPI 1.0 specification.

?? [3.4.3] **System presents minimal start-up display.** System start-up must only draw the end user's attention in case of errors or when there is a need for user action. By default, the system must be configured so the screen display does not display memory counts, device status, and so on, but presents a "clean" BIOS start-up, allowing a manufacturer's branding message and hot-key or end user action notices.

~~The default configuration must allow a beep during the boot process only in case of an error. The only screen display allowed is the OEM splash screen, which can include information such as copyright notices.~~

~~However, the system start-up process can include the following:~~

~~? Manufacturer branding messages.~~

~~? A blank start-up screen.~~

~~? A hot-key override to display screen messages for troubleshooting or to display user-definable CMOS settings.~~

~~? Text-based messages related to end-user action. Examples are: messages to display the setup hot key, the system help hot key, password entry, network log on for remote booting, and so on.~~

~~? A CMOS option to turn the clean start-up screen off and on.~~

### [3.5.] BIOS meets PC 2001 requirements for boot support

This requirement does not apply for Alpha architecture.

ACPI BIOS entries, as defined in Section 1.6 of the ACPI 1.0a.x or later specification., should be the same for supporting either Windows 98 or Windows 2000. ~~In general, the run-time services portion of the Plug and Play BIOS is replaced by ACPI and therefore is not required. The Extended System Configuration Data (ESCD) calling interface is not supported by Windows 98 or Windows 2000.~~

The BIOS boot support requirements include the following:

?? [3.5.1] **BIOS supports preboot execution environment, with unique system ID provided in print.** For Desktop PCs, the system's execution environment must conform to the description given in "Attachment B: Preboot Execution Environment" of *Network PC System Design Guidelines*

**Note to Reviewers: This section might be placed in separate platform-specific chapters for the 0.5 draft: Workstation, Desktop and Mobile sections.**

For desktop and workstation systems, this requirement means providing a unique PXENV system identifier (ID) structure in the system BIOS or CMOS, as defined in "Attachment B: Preboot Execution Environment" of *Network PC System Design Guidelines*.

In addition, for all Desktop PC and Workstation PC systems, the unique system ID must be provided to the user in printed form, for assistance in environments where it might be used as part of pre-staging systems. This mechanism is left up to the system manufacturer, but suggested means include posting the unique system ID on the system chassis or case, or printing it on the shipping carton.

Mobile PC Note

Only mobile PCs that ship with an integrated network adapter are required to provide the unique system ID in printed form. Initially, the unique system ID will be used for creating a Machine Account Object for the remote installation service. Currently, no Microsoft operating system supports remote installation using a PC Card network adapter.

?? [3.5.2] **BIOS supports booting the system from a CD or DVD device.** For any system that includes a CD drive or DVD drive, the system BIOS or option ROM must support the No Emulation mode in *El Torito—Bootable CD-ROM Format Specification, Version 1.0*, by IBM and Phoenix Technologies, Limited, or an equivalent method that supports the process for installing Windows from compact disc.

?? [3.5.3] **BIOS supports booting the system from the network and using F12 to force a system boot.** For any system that includes a network adapter, the system BIOS must comply with the requirements defined in Sections 3 and 4, as they apply to Plug and Play devices, of the Compaq, Intel, Phoenix BIOS Boot Specification, Version 1.01, which describes the requirements for Initial Program Load (IPL) devices.

**Note to Reviewers: Please comment on this new requirement.**

The system must also allow all boot devices to be configured as to order of precedence for boot. This mechanism must clearly show how the system will order boot devices when end users are making configuration choices. For example, in a system that permits booting from floppy drive, hard drive, CD or DVD drive, and network adapter, it must be clear to the end user how to set a boot order that favors a specific device, such as the network adapter.

In addition, for any system that includes a network adapter, support must be provided for using the F12 key sequence ~~must be provided~~ to invoke a pop-up screen that allows the user to force a system boot initiated from the network adapter. This key sequence must be enabled by default. Configuration of this feature can be provided through a CMOS configuration setting. When this feature is enabled, the boot display must indicate the key sequence that will invoke the pop-up screen that would allow a network boot. This display must appear for a duration sufficient to be read by users, but must not lengthen the overall time needed to boot the machine.

This feature must be implemented in accordance with Appendix C of the *Compaq, Intel, Phoenix BIOS Boot Specification, Version 1.01*. This feature is a PC 2001 requirement, although it is optional in the *BIOS Boot Specification*.

~~For a consistent user experience across all system brands and types, it is suggested that system and BIOS manufacturers standardize on the F12 key to perform this action. It is expected that F12 or another standard key sequence will become a requirement in future versions of the design guidelines.~~

?? **[3.5.4] BIOS properly accommodates all dates.** Dates, including the year 2000 and beyond, correctly supported in BIOS and CMOS.

?? **[3.5.5] BIOS on Office-PC supports security.** All Office-PC systems must provide some mechanism for security, such as a pre-boot password, to protect enable/disable capabilities for hardware components before the operating system boots.

~~This capability is also recommended for other system types. The purpose of this feature is to prevent end users from accidentally or purposefully circumventing operating system-level security and control as applied by an administrator.~~

?? **[3.5.6] BIOS supports BIOS updates and revisions.** BIOS updates must be implemented in order for BIOS ROMs to be upgraded to a new image through OEM-provided programs. The following methods can be used to meet this requirement:

?? Through a remote new system setup mechanism downloaded and executed at boot time as described in Chapter X, "Network Communications"

?? Through a normal file access and execution methods when the system is fully booted into the normal operating system environment

If option ROMs are provided, they must also be capable of being upgraded.

~~Recommended:~~ OEMs are encouraged to implement a mechanism to authenticate the requester of the update programming and a mechanism to validate that the program arrived intact after download.

- ?? [3.5.7] **BIOS provides boot support for USB keyboards and hubs.** For systems based on Intel Architecture compatible processors, the system BIOS must provide boot support for USB keyboards and hubs as defined in *Universal Serial Bus PC Legacy Compatibility Specification, Version 0.9* or later. This support must provide the ability for the user to enter the system's BIOS setup program and provide enough functionality to get a USB-aware operating system installed and booted.

Mobile PC Note

Mobile PCs, which have built-in keyboards, are exempt from this requirement for BIOS support of USB keyboards.

- ?? [3.5.8] **System BIOS supports ~~console redirection of a serial port~~ debugging port solution.** This capability provides support during system startup for debugging and troubleshooting activities. On a legacy-free system, the implementation must meet the requirements defined in *Microsoft Debug Port Specification, Version 1.0* or later.

If a legacy serial port is implemented, the BIOS must provide an option to configure at least one legacy serial port to use either 2F8h or 3F8h. This capability allows the port to be treated as a boot device by the BIOS and is required to be usable by components as a diagnostic port in the event that system debugging is required by either the BIOS or the operating system.

**Note to Reviewers: A review draft of the Debug Port specification will be available in Q3 1999 at <http://www.microsoft.com/hwdev/newpc/>.**

- ?? **If the system includes an ATAPI bootable drive, BIOS supports boot.** System BIOS or option ROM provides boot support for primary ATAPI bootable floppy disk drive in compliance with *ATAPI Removable Media BIOS Specification (ARMD), Version 1.0* or later. Complying with this specification provides Int 13h and Int 40h support for bootable floppy drives as the primary or secondary floppy device.

- ~~?~~ [3.45.] **System BIOS and option ROMs support Int 13h Extensions.** This requirement applies for systems that run either Windows 98 or Windows 2000, but does not apply for Alpha architecture. This requirement also applies for RAID controllers when implemented. ~~on client systems, such as workstations.~~

~~The Int 13h Extensions ensure correct support for high-capacity drives. Support for the fixed-disk access subset of Int 13h Extensions must be provided in the system BIOS and in any option ROMs for storage devices that include BIOS support. The Int 13h Extensions are defined in the "Layered Block Device Drivers" section of the Windows 98 DDK.~~

?? [3.49.] **Operating system recognizes the boot drive in a multiple-drive system.** The implementation of boot-drive determination in multiple-drive systems is defined in Section 5.0 of the *Compaq, Intel, Phoenix BIOS Boot Specification, Version 1.01*. ~~This is the format that b~~Both Windows 98 and Windows 2000 operating systems use this format for determining the boot drive when new bootable devices are introduced to a PC. The system designer can use an equivalent method for boot-drive determination but the method must ensure that the Windows 98 and Windows 2000 operating systems recognize the boot drive.

?? **[NEW] BIOS on a legacy-free system must meet the PC 2001 legacy-free BIOS requirements.** These are defined in the “Legacy Free Guidelines” in Chapter X, “Easy PC System.”

**Note to Reviewers: Additional details about the required BIOS behavior on legacy-free and legacy-reduced PCs will be provided in v.0.5.**

## PC 2001 Physical Design Requirements

This section summarizes physical design requirements and recommendations for PC 2001 systems. These requirements are in addition to those related to the OnNow and Instantly Available PC initiatives for power-state indicators and easily accessible power switches.

~~3.6. [DELETE] All expansion slots in the system are accessible for users to insert cards~~

### [3.7.] Audible noise meets PC 2001 requirements

A PC 2001 system must be “silent” in any sleep state. That is, it must be perceived as not significantly noisier than the off state to typical users, relevant to an operating position appropriate to the PC’s form factor (such as desktop, minitower, or laptop) and the ambient noise level of its normal usage environment (such as corporate office, home office, family room, and so on). This requirement applies primarily to fan noise, as all other devices will not be active in the sleep state.

~~It is hoped that this definition will become more objective over time through standardization of acoustic noise measurement and reporting procedures for PCs. Intel and Microsoft are working on proposals for acoustic noise measurement and reporting. The goal is to achieve common PC acoustic noise measurement methods based on established international standards. With such methods in place, end users will be able to receive reliable acoustic noise specifications about PCs similar to those available for other product categories such as automobiles and appliances.~~

The goal is to achieve quieter PCs based on established international standards through acoustic noise measurement and reporting procedures. Intel and

Microsoft are working on proposals for acoustic noise measurement and reporting.

Although this requirement does not specify noise limits for PCs in idle and working states, manufacturers are encouraged to design systems that operate as quietly as possible, especially PCs designed for use in the home family room.

**[3.8.] System and component design practices follow accessibility guidelines**

At a minimum, the OEM must:

?? Ensure that the keyboard and other input devices work correctly with the Microsoft Accessibility features in Windows. For example, Sticky Keys must work with all keys in any keyboard design.

?? TBD: Meet the international design requirements that must be met under new legal guidelines for accessibility, such as those being published by the U.S. government.

?? Make all modifier keys capable of being read and operated by software, including Fn and similar OEM-specific keys. This capability allows users to access these keys and the functions that rely on them through operating system features, such as StickyKeys and SerialKeys, and through third-party software such as voice recognition.

**Note to Reviewers: PC 2001 v.0.5 will propose new “accessibility” requirements to meet these goals. Accessibility design guidelines are provided in PC 99 System Design Guide, Appendix C, “Accessibility.” These guidelines were developed in consultation with the Trace Research and Development Center at the University of Wisconsin at Madison, see the web site at <http://trace.wisc.edu>.**

~~**3.9. [DELETE] Internal system modification capabilities are not accessible to end users**~~

~~**3.10. [DELETE] System design provides physical security**~~

## PC 2001 General Device Requirements

The requirements in this section apply for every device, whether present on the system board or as an expansion device provided by the OEM in a default system configuration. Most general device requirements are related to Plug and Play capabilities.

**[3.11.] Each device and driver meets PC 2001 device requirements**

Each device must comply with all requirements defined in this guide for the related device class, whether the device is provided in the PC system as an expansion card or as an external device.

Drivers must be provided for both Windows 98 and Windows 2000 operating systems. The manufacturer does not need to supply a driver for a device if the device passes PC 2001 compliance testing using a driver provided with the operating system.

In addition to the device requirements in this section, see also the specific requirements for each device class in this guide.

### **[3.12.] Each bus and device meets Plug and Play specifications**

Each bus and device provided in a PC 2001 system must meet the current Plug and Play specifications related to its class, including requirements defined in Section 6 of the ACPI 1.0 specification and clarifications published for some Plug and Play specifications. This guideline includes requirements for automatic device configuration, resource allocation, and dynamic disable capabilities.

Any legacy components remaining in a legacy-reduced system must meet the requirements defined in *Legacy Plug and Play Guidelines* (available at <http://www.pcdesguide.org/library.htm>), which contains all the requirements for legacy Plug and Play, as published in *PC 99 System Design Guide*.

For information about Plug and Play support under Windows 2000, see the Windows 2000 Device Driver Kit (DDK).

The following list shows current version numbers for all Plug and Play specifications:

- ?? *PCI Local Bus Specification, Revision ~~2.1~~2.2*
- ?? *Plug and Play External COM Device Specification, Version 1.0*
- ?? *Plug and Play Industry Standard Architecture (ISA) Specification, Version 1.0a, and Clarification to Plug and Play ISA Specification, Version 1.0a*
- ?? *Plug and Play Parallel Port Device Specification, Version 1.0b*
- ?? *Plug and Play Small Computer System Interface Specification, Version 1.0*
- ?? *Universal Serial Bus Specification, Version 1.0*

Plug and Play specifications for IEEE 1394 are defined in this guide. For information, see Chapter X, “Buses and Interfaces.”

### **[3.13.] Unique Plug and Play device ID provided for each system device and add-on device**

Each device connected to an expansion bus must be able to supply its own unique ID. The following are the specific requirements for Plug and Play device IDs:



?? Each separate function or device on the system board must be separately enumerated; therefore, each must provide a device ID in the manner required in the current Plug and Play specification for the bus it uses.

?? If a device on an expansion card is enumerated by the BIOS, it must have a unique ID and its own resources according to the current device ID requirements for the bus to which the card is connected. This requirement includes devices that are separately enumerated on multifunction cards or multifunction chips.

Multifunction CardBus devices must meet the requirements defined in the multifunction standards for CardBus designs defined by PCMCIA (see <http://www.pc-card.com/papers/multifunc.htm>). Driver implementation for Windows 2000 is defined in the Windows 2000 DDK (see the information about Mf.sys).

In addition, for ~~for Office PCs, desktops and workstations,~~ if an OEM uses a proprietary mechanism to assign asset or serial numbers to hardware, this information must be available to the operating system using Windows hardware instrumentation technology, as defined in the *Network PC System Design Guidelines, Version 1.0b*.

Legacy devices attached to the ISA bus on the system board ~~do not~~ are not required to have unique Plug and Play IDs—for example, serial ports, parallel ports, or Personal System/2 (PS/2) compatible port devices. For information, see *Legacy Plug and Play Guidelines*.

Some multifunction devices, such as Super I/O, might include devices that ~~do not~~ are not required to have unique Plug and Play IDs or unique PCI subsystem IDs, but that are supported by drivers provided with the Windows operating system.

A device such as a multifunction PCI device that supports a number of functions but uses only a single set of relocatable resources ~~does not have~~ is not required to provide separate IDs for each function included on the device.

#### **[3.14.] Option ROMs meet Plug and Play requirements**

For implementation details, see *Legacy Plug and Play Guidelines*. Systems designed to run only on Windows 2000 are not required to meet these requirements for legacy Plug and Play support.

#### **[3.15.] “PNP” vendor code used only to define a legacy device’s Compatible ID**

For implementation details, see *Legacy Plug and Play Guidelines*.

#### **[3.16.] Device driver and installation meet PC 2001 requirements**

Each device must have drivers for both Windows 98 and Windows 2000 operating systems to ensure correct support under both operating systems. For



some device classes, this support can be provided using a Windows Driver Model (WDM) driver, as defined in the related device requirements in this guide.

The manufacturer does not need to supply a driver for a device if the device passes PC 2001 compliance testing using a driver provided with the operating system. If the manufacturer does supply a driver, it must meet the requirements for device drivers and installation under Windows 98 and Windows 2000 include the following:

~~?? [3.16.1] All devices and drivers must pass PC 2001 compliance testing. Each device included in a system must comply with the requirements defined in these guidelines and must have supporting 32-bit device drivers for the CPU-platform and operating system.~~

~~Each device must have a driver for both Windows 98 and Windows 2000. A device is not required to have a driver for both CPU platforms, but a system must include the correct device drivers for the platform.~~

~~The installation and loading of a driver must not reduce or eliminate functionality of other devices installed on the system.~~

~~For systems that come with Windows 2000 pre-installed, only 32-bit protected-mode components must be installed. No real-mode or 16-bit protected-mode components can be provided in order to operate under Windows 2000.~~

~~Under Windows 98, the graphics adapter driver is a Win16 module. All other components must be 32-bit protected-mode components.~~

?? [3.16.2] **Devices with WDM support in Windows include WDM-based drivers.** For any device for which WDM-based support is provided in the operating system, the driver supplied by the manufacturer must be a WDM minidriver. This requirement applies whether the system comes pre-installed with Windows 98 or Windows 2000.

?? [3.16.3] **Driver supports Plug and Play and power management IRPs.**

Every driver (or minidriver) must support Plug and Play and power management I/O request packets (IRPs). This requirement applies whether the system comes pre-installed with Windows 98 or Windows 2000.

For VxD drivers for Windows 98, the following requirements apply:

?? Every VxD must support Plug and Play and power management messages.

?? The driver must provide power management support as required by any device class power management reference specification.

?? [3.16.4] **All configuration settings are stored in the registry.** The driver must not use initialization files (INI) for configuration settings.

The driver must also include correct provider, version, and copyright entries. This information is displayed in the user interface, such as Device Manager in Windows.

?? **[3.16.5] All INF and other file information is correct.** The correct minidriver, virtual device drivers (VxDs), or any other manufacturer-supplied files specified in the device's information file (INF) must be installed in the correct location.

For manufacturer-provided files, the vendor must *not* be identified as Microsoft and all other copyright and version information must be correct for the manufacturer.

Files provided by the vendor must not use the same file names as used by files included in Microsoft operating systems and provided as either retail or OEM products, unless specifically agreed upon with Microsoft.

?? **[3.16.6] Installation uses methods defined in the DDK.** Driver installation and removal must use Windows-based methods, as defined in the Windows 98 and Windows 2000 DDKs.

The device driver must be able to be removed using Windows-based software, which can be managed using either the Windows Control Panel option for removing devices or its own remove utility. For information, see the driver installation information in the \SRC\General directory in the Windows 2000 DDK; see also "Windows 95 Class Installers and Network Driver Installers" in the Windows 95 DDK.

However, any software applications included with the device can be installed using an alternate Windows-based installation method as defined in the Microsoft Platform Software Developers Kit (SDK).

Also, any software components and registry entries installed during driver installation must be removed during driver un-installation.

Any real-mode components provided for backward compatibility under Windows 98 should use separate installation procedures. Although installation of Windows-based components must not make entries in Autoexec.bat or Config.sys, the separate real-mode installation program can make such entries but must not modify the registry, Win.ini, or System.ini.

?? **[3.16.7] Driver supports unattended installation.** It must be possible for the device's driver to be installed using a mechanism, such as a script or special software for supplying required parameters, without the user being present.

?? **[3.16.8] Driver includes Help file if special parameters are used.** To ensure that the user can correctly change settings, a Windows Help file must be provided if special driver parameters are used. The device's installation routine must install the Help file as part of the setup program. The user interface for the device's dialog boxes must display the correct Help file, and the Help file must contain relevant information to assist the user. The guidelines for implementing a Help file are defined in the Windows 2000 DDK.

**[3.17.] Minimal user interaction needed to install and configure devices**

After physically installing the device, the user must not be required to perform any action other than to insert the disks that contain drivers and other files. The user should have to restart the system only for devices that do not support hot plugging.

As specified in requirement 3.19, “Hot-plugging capabilities for buses and devices meet PC 2001 requirements,” devices that use USB, IEEE 1394, or PC Card must support hot-plugging. For devices that use other buses, detection occurs when the system is powered on after the device is inserted.

The following requirements must be met:

?? **[3.17.1] The device is immediately functional without restarting the system.** It is acceptable to require rebooting for primary system devices such as the primary graphics adapter and the primary hard disk controller; furthermore, ATA drives are not required to implement Cable Select (CS) settings. In all cases, however, changing configuration settings must not require the end user to make jumper changes.

?? **[3.17.2] Software settings are available for configuring all resources.** All buses and devices on both the system board and all expansion cards must be capable of being configured by the operating system and by software, such as the Device Manager in Windows, so that the user does not need to open the PC case to change the configuration. DIP switches on boot devices can be used for an initial power-on default state or for non-Plug and Play system compatibility, but such settings must be capable of being overridden by software configuration after power on occurs under Plug and Play operating systems.

**Note:** This requirement does not apply for jumper settings used by the OEM to set CPU speed, select a keyboard, or make other basic system-related settings in the factory. This requirement applies only for settings that the end user must make to configure the hardware.

?? **[3.17.3] Dynamic disable capabilities are supported for all devices.** All devices must be capable of being automatically disabled by the system. Also, disabling the device must result in the freeing of all its resources for use by other devices.

The following devices are exempt from this requirement: all legacy devices using the I/O range under 100h, keyboard controller, floppy disk controller (FDC), hard disk controller, VGA memory and I/O addresses, and any BIOS memory ranges required for legacy boot support.

**[3.18.] Connections use icons, plus keyed or shrouded connectors, with color coding**

**Note to Reviewers: Many have called for new standard designs that are easier to discern and manufacture. In your v.0.3 review comments, please propose a solution for developing new standard icons.**

This requirement helps ensure that the end user can correctly make the physical connections required for adding a device to a system. This requirement includes the following:

?? **[3.18.1] Connector's physical design ensures that the user cannot insert it into the wrong port.** Wherever possible, keyed or shrouded connectors or other configurations should be used to prevent misconnection. For specific requirements related to keyed connectors and cables for I/O controllers and peripherals, see Chapter X ["Buses and Interfaces."](#)

?? **[3.18.2] Icons are provided for all external connectors.** The icons can be molded, printed, or affixed as permanent stickers, which can include text. Icons can be based on existing vendor designs or on the examples listed on <http://www.pcguide.org>.

*Mobile PC Note*

For mobile PC designs, connector icons might not fit on the back of the case. In such designs, it is acceptable to wrap the icons to the bottom of the unit or place them on the inside of an access door.

?? **[3.18.3] Systems and retail peripherals use a color-coding scheme for connectors and ports.** All PC 2001 systems must implement a color-coding scheme for their ports and device connectors.

Color coding is required for all desktop system and device connectors. The standard color coding using the colors published in *PC 99 System Design Guide* is required for all non-legacy devices. These required color codes must be implemented on PC desktop systems and on retail peripherals.

Standard colors are *not* required for the following legacy devices (because these cannot be included with PC 2001 systems): MIDI/game, parallel, serial, and PS/2 keyboard and mouse.

**Required Color Codes for Connectors**

Connector	Color	Pantone
Analog VGA	Blue	661C
Audio line in	Light blue	284C
Audio line out	Lime	577C
Digital monitor/flat panel	White	
IEEE 1394	Grey	424C
Microphone	Pink	701C
MIDI/game	Gold	131C
Parallel	Burgundy	235C
PS/2-compatible keyboard	Purple	2715C
PS/2-compatible mouse	Green	3395C
Serial	Teal or Turquoise	322C
Speaker out/subwoofer	Orange	157C
Right-to-left speaker	Brown	4645C
USB	Black	426C
Video out	Yellow	123C
SCSI, network, telephone, modem, and so on	None	—

*Mobile PC Note*

Mobile PCs are not required to comply with the requirement for color coding.

### [3.19.] Hot-plugging capabilities for buses and devices meet PC 2001 requirements

**Note to Reviewers:** In the 0.5 draft, these requirements might be in the appropriate chapters for technologies, such as USB or IEEE 1394.

~~Recommended: A locking mechanism to ensure that devices are removed only under operating system control or during sleep or off states.~~

To ensure reliable support for hot-plugging capabilities, the following requirements must be met:

?? **[3.19.1] USB, IEEE 1394, and PC Card devices and buses support hot-plugging.** When designed under their respective specifications, USB, IEEE 1394, and PC Card all support hot-plugging. Any device designed to use any of these connections must support being added or removed while the system is fully powered on.

The exception to this requirement is any device required for booting such as the primary graphics adapter. For information about supporting multiple graphics adapters, see Chapter X, “Graphics Adapters.”

**?? [3.19.2] Hot-plugging for PCI devices uses ACPI-based methods.**

Hot-plugging is not required for PCI devices. Windows 98 and Windows 2000 support dynamic enumeration, installation, and removal of PCI devices only if there is a supported hardware insert/remove notification mechanism. The notification mechanism is defined as part of the bus standard for CardBus bus controllers. For other solutions, such as those required for docking stations or other devices, the hardware insert/remove notification mechanism must be implemented as defined in Section 5.6.3 of the ACPI 1.0a specification.

In order to properly function with the native support in the operating system, developing industry standards such as those referred to as PCI Hot Plug and Compact PCI must use ACPI-based methods for supporting hardware insertion and removal as defined in the ACPI 1.0a specification.

**?? [3.19.3] All removable media support media status notification.** For details, see Chapter X, “Storage.”

For implementation details and for additional design guidelines, see the article about hot-plugging support at [http://www.microsoft.com/hwdev/busbios/rem\\_devs.htm](http://www.microsoft.com/hwdev/busbios/rem_devs.htm).

**[3.20.] [REDUNDANT] System includes Device Bay 1.0-compatible bay**

**Note to Reviewers: See the “Buses and Interfaces” chapter.**

**[3.21.] If implemented, multifunction add-on devices meet PC 2001 device requirements for each device**

**Note to Reviewers: Microsoft is preparing a draft specification in Q3 1999 that describes how a multifunction device must be implemented to ensure it works correctly with Windows 2000 and Windows 98. This specification is expected to replace the requirement stated in PC 99; however, a draft is not yet available for review.**

Multifunction add-on devices can contain more than one device. They must comply with requirement 3.16, “Device driver and installation meet PC 2001 requirements,” including the requirements for automated software-only settings for device configuration, device drivers, and Windows-based installation. In addition, the following requirements must be met:

**?? [3.21.1] Each enumerated device has a unique device ID.** Each function or device on the multifunction add-on device that is individually enumerated by the BIOS must provide a device ID for the bus it uses.**?? [3.21.2] System can separately access and configure each logical device.**

The system must be able to separately access each logical device that is individually enumerated by the BIOS, configure the device resources independently, and disable individual devices in the event of a conflict.

**?? [3.21.3] Each enumerated device meets its own resource requirements.**

For each individually enumerated device, resource configuration requirements are the same as for an equivalent device on a separate expansion card. This requirement means that registers cannot be shared among individually enumerated devices on a multifunction add-on device, but it does not supersede device requirements among different bus classes.

The exception to this requirement is a device such as a multifunction PCI device that supports several functions but uses only a single set of relocatable resources. When each device is not individually enumerated, there is no requirement to provide separate IDs and resources for each function on the device. However, see also requirement 9.8, “Functions in a multifunction PCI device do not share writeable PCI Configuration Space bits.”

This exception refers solely to multifunction devices *of the same device class*. If different functions within a multiple-function device require separate class drivers—for example, a combination PCI network adapter and modem—then each function must provide a unique PCI SID and SVID that will allow the proper driver to be loaded for each separate function.

Multifunction devices that contain functions from separate classes will not be properly recognized during an operating system upgrade—and therefore drivers will not be properly upgraded—unless unique IDs are provided for each device.

Note that a “supervisory” driver that loads different drivers for the individual functions does not work well with Windows. In particular, driver support is likely to be lost in cases of operating system re-installation or upgrade, or with distribution of new drivers via Windows Update. Therefore, these supervisory drivers should be avoided.

For PC 2001, separate drivers are required for separate functions.

**[3.22.] All devices support correct 16-bit decoding for I/O port addresses**

For implementation information, see *Legacy Plug and Play Guidelines*.

**[3.23.] [REDUNDANT] All PC 2001 input devices support Microsoft DirectInput and work simultaneously**

**Note to Reviewers: See the Input chapter.**

**[3.24.] Each bus meets written specifications and PC 2001 requirements**

~~In the past, some bus designs did not fully implement all of the bus requirements on every expansion card connector.~~ Each bus and connector used in the system must meet all the requirements for that bus as defined in Chapter X, “Buses and Interfaces.”

Each bus and device provided in a PC 2001 system must also meet the current Plug and Play specifications related to its class, including requirements defined in

the ACPI 1.0a or later specification and the clarifications published for some Plug and Play specifications. This [guideline](#) includes requirements for automatic device configuration, resource allocation, and dynamic disable capabilities.

**[3.25.] [REDUNDANT] System includes USB with X USB ports, minimum**

**Note to Reviewers: See the USB section in the Buses chapter**

**[3.26.] [REDUNDANT] System includes support for IEEE 1394**

**Note to Reviewers: See the IEEE 1394 section in the Buses chapter**

**[3.27.] [REDUNDANT] If present, PCI bus meets PCI 2.1 or later, plus PC 2001 requirements**

**Note to Reviewers: See the PCI section in the Buses chapter**

**[3.28.] System does not include ISA expansion devices or slots**

ISA expansion devices cannot be included in a PC 2001 system, and systems must not include user-accessible ISA slots.

It is acceptable for all PC 2001 systems to use ISA protocols and signaling or ISA-like protocols and signaling for implementations of on-board legacy devices. For such implementations, interrupts are supported using the legacy 8259 or APIC (for Windows 2000). ~~It is recommended that APIC be used in all designs.~~ Any on-board legacy implementations, such as BIOS ROM, Super I/O, 8042 controllers, math coprocessors, and so on, are allowed and must meet the requirements defined in *Legacy Plug and Play Guidelines*.

These on-board legacy devices should be implemented using alternative bus extensions such as Low Pin Count (LPC) rather than ISA. The LPC Interface allows the legacy I/O on-board components, typically integrated in a Super I/O chip, to migrate from the ISA/X-bus to the LPC Interface while retaining full software compatibility. The *Low Pin Count Interface Specification* is available from the web site at <http://developer.intel.com/design/pcisets/lpc/index.htm>.

## PC 2001 I/O Devices and Peripherals

See the details in specific chapters later in this guide.



~~3.29. [DELETE] System includes keyboard connection and keyboard~~

~~3.30. [DELETE] System includes pointing device connection and pointing device~~

~~3.31. [DELETE] System includes connection for external parallel devices~~

~~3.33. [DELETE] System includes IR devices compliant with IrDA specifications~~

**[3.34.] System includes PC 2001-compatible CD or DVD drive and controller**

~~3.35. [DELETE] System includes audio support that meets PC 2001 requirements~~

**[3.36.] System includes a modem or other public network communications support**

**[3.37.] System includes a 10-BaseT or HomePNA solution**

**Note:** It is recognized that OEMs supply PC systems to corporations with specific feature requirements. For example, a customer might want to insert network adapters at the end-user site. A PC system submitted for compliance testing must include a network adapter.

~~3.38. [DELETE] System includes smart card support~~

~~3.39. — 3.44 [DELETE] Graphics adapter meets PC 2001 minimum requirements~~

**Note to Reviewers:** See the Graphics/Video chapter for related requirements.

**3.45. [MOVED] System BIOS and option ROMs support Int 13h Extensions**

**Note to Reviewers:** See BIOS boot requirements earlier in this chapter.

~~3.46. — 3.48 [DELETE]~~

**Note to Reviewers:** See the Storage chapter for related requirements.

**3.49. [MOVED] Operating system recognizes the boot drive in a multiple-drive system**

**Note to Reviewers:** This text moved to guideline 3.5.

**[3.50.] Floppy disk capabilities, if implemented, do not use legacy FDC**

To support migration away from legacy devices, floppy disk drives on PC 2001 systems must be based on a solution other than an FDC. Solutions could include an MMC-2-compliant ATAPI floppy drive, USB, PC Card, SCSI, or an ATA expansion card. For implementation details, see Chapter X, “Storage.”

**Note to Reviewers:** Please comment on the technical feasibility of this legacy reduction goal for systems manufacturers for 3Q 2001 and later.

I/O devices may move to platform specific chapters instead of this core chapter.

## Manageability Component Instrumentation Requirements

This section presents new requirements ~~and recommendations~~ for PC 2001 systems related to the Wired for Management (WfM) initiative and the Zero Administration initiative for Windows. The WfM initiative seeks to raise the level of management capabilities for mobile, desktop, and server platforms. The Zero Administration initiative seeks to ensure a controlled, highly manageable enterprise.

The baseline for these requirements is *Windows Hardware Instrumentation Implementation Guidelines, Version 1.0* (WHIIG), which also defines the Windows-specific requirements of the *Wired for Management Baseline Specification, Version 2.0*, for hardware instrumentation.

Collectively, the items in this section represent the Manageability Baseline requirements for Office PC 2001. Platform management information requirements are defined for two key areas:

- ?? Component instrumentation: Interfaces through which information is supplied by platform management components.
- ?? Management information providers: Interfaces used by applications to access platform management information.

**Tips for implementing management capabilities.** For PC 2001 systems and components, these are the design steps to pursue:

- ?? For each component, implement the component instrumentation features defined for PC 2001 systems in WHIIG.
- ?? For each component, extend the Web-Based Enterprise Management (WBEM) and Common Information Model (CIM) schema to expose the device's custom features in any CIM-ready management browser.
- ?? For all instrumented components, test against the baseline features required in WHIIG.
- ?? For those components that require Windows Management Instrumentation (WMI), ensure that WMI is enabled in device minidrivers as defined in the Windows 2000 DDK.
- ?? Refer to WHIIG for other driver requirements and design tips.

**[3.51.] System supports WHIIG**

The related requirement is defined in *Windows Hardware Instrumentation Implementation Guidelines, Version 1.0*.

*Mobile PC Note*

Support for WHIIG, WMI, and enabling a management information service provider are required for mobile systems that come with Windows 2000 preinstalled.

**[3.52.] System includes driver support for WMI**

Requirements ~~and recommendations~~ related to implementing WMI for Windows 2000 and Windows are defined in WHIIG.

Support for WMI, CIM, and Win32 extension schema objects and data must be implemented as defined in WHIIG.

**[3.53.] Management information service provider enabled by default**

The management information service providers must be enabled on Office PC 2001 systems as defined in WHIIG.

Also, newly developed applications for managing WBEM-capable systems must comply with the appropriate CIM schema specifications and Windows-based applications programming models.

**[3.54.] Expansion devices on desktop systems can be remotely managed**

Devices provided as expansion devices must be capable of being remotely managed to ensure that control and TCO policies can be realized. For example, for any implementation of a floppy disk drive on an Office PC system, the drive must be capable of being remotely disabled as a boot selection and provisions must be made for locking.

~~It is not a requirement that e~~Certain devices are not required to be capable of being remotely disabled, including the primary hard disk drive, the network adapter, and any standard devices that use legacy connections, such as a keyboard or pointing device that uses a PS/2-compatible connection. However, it must be possible that permissions, policies, or other methods can be used to remotely manage capabilities such as hard disk access or to control end-user ability to change the MAC address or configuration settings for the network adapter.

See also requirement 3.5, “BIOS meets PC 2001 requirements for boot support.”

**[3.55.] SMBIOS 2.2 static table support is provided**

Windows 2000 can present SMBIOS 2.2 or later static table data in WBEM. System designers can provide platform-specific static information at boot time using this mechanisms. For more information about SMBIOS, see *System Management BIOS Reference Specification, Version 2.2*.

SMBIOS static table support is likely to become a requirement in future versions of these guidelines.

## Checklist for PC 2001 Core System Guidelines

- [3.1.] System performance meets PC 2001 minimum requirements*
- [3.2.] System design meets ACPI x.x specification and PC 2001 requirements*
- [3.3.] Hardware design supports OnNow and Instantly Available PC initiatives*
- [3.4.] BIOS meets PC 2001 requirements for OnNow/Instantly Available PC support*
- [3.5.] BIOS meets PC 2001 requirements for boot support*
- [3.7.] Audible noise meets PC 2001 requirements*
- [3.8.] System and component design practices follow accessibility guidelines*
- [3.11.] Each device and driver meets PC 2001 device requirements*
- [3.12.] Each bus and device meets Plug and Play specifications*
- [3.13.] Unique Plug and Play device ID provided for each system device and add-on device*
- [3.14.] Option ROMs meet Plug and Play requirements*
- [3.15.] "PNP" vendor code used only to define a legacy device's Compatible ID*
- [3.16.] Device driver and installation meet PC 2001 requirements*
- [3.17.] Minimal user interaction needed to install and configure devices*
- [3.18.] Connections use icons, plus keyed or shrouded connectors, with color coding*
- [3.19.] Hot-plugging capabilities for buses and devices meet PC 2001 requirements*
- [3.20.] [REDUNDANT] System includes Device Bay 1.0-compatible bay*
- [3.21.] If implemented, multifunction add-on devices meet PC 2001 device requirements for each device*
- [3.22.] All devices support correct 16-bit decoding for I/O port addresses*
- [3.23.] [REDUNDANT] All PC 2001 input devices support Microsoft DirectInput and work simultaneously*
- [3.24.] Each bus meets written specifications and PC 2001 requirements*
- [3.25.] [REDUNDANT] System includes USB with  $\geq$  2 USB ports, minimum*
- [3.26.] [REDUNDANT] System includes support for IEEE 1394*
- [3.27.] [REDUNDANT] If present, PCI bus meets PCI 2.1 or later, plus PC 2001 requirements*
- [3.28.] System does not include ISA expansion devices or slots*
- [3.34.] System includes PC 2001-compatible CD or DVD drive and controller*
- [3.36.] System includes a modem or other public network communications support*
- [3.37.] System includes a 10-BaseT or HomePNA solution*
- 3.45. [MOVED] System BIOS and option ROMs support Int 13h Extensions*
- 3.49. [MOVED] Operating system recognizes the boot drive in a multiple-drive system*
- [3.50.] Floppy disk capabilities, if implemented, do not use legacy FDC*
- [3.51.] System supports WHIIG*
- [3.52.] System includes driver support for WMI*
- [3.53.] Management information service provider enabled by default*
- [3.54.] Expansion devices on desktop systems can be remotely managed*
- [3.55.] SMBIOS 2.2 static table support is provided*